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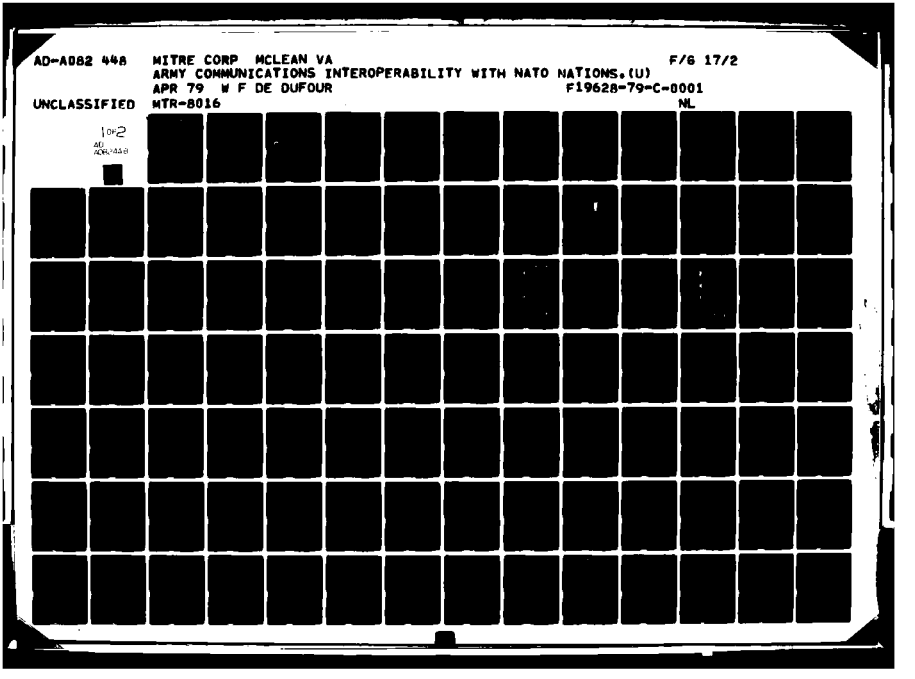

Army Communications Interoperability with NATO Nations

William F. de Dufour

The MITRE Corporation

MTR-8016

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MITRE Technical Report
MTR-8016

Army Communications Interoperability with NATO Nations

William F. de Dufour

April 1979

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The MITRE Corporation
MITRE C^3 Division
Washington C^3 Operations
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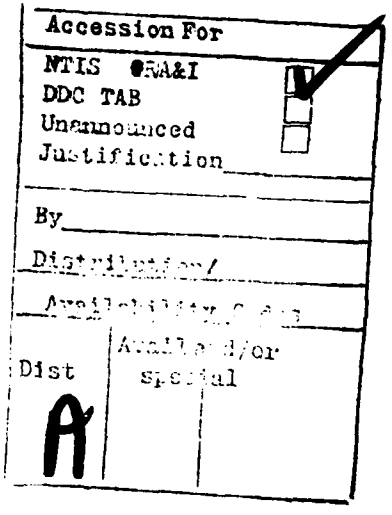
ABSTRACT

This paper describes the tactical communications systems (i.e., switched, combat net radio, mobile subscriber, satellite ground terminals, and data distributions) of the major NATO countries. An appraisal of the interoperability among like systems is provided, and areas wherein improvements could be made are identified. Details of the various systems are provided in appendices.



IN MEMORIAM

Tragically, Bill de Dufour died suddenly on January 29, 1979. He had been at MITRE for almost ten years. His work spanned many aspects of MITRE's national security programs. At the time of his death he had completed a final draft of this report and was looking forward to polishing and improving the text to reflect the comments of several reviewers.

We, his colleagues in Department W-71, have done that task for him. We hope we did not detract from his effort; we trust he would approve of our endeavors.

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GLOSSARY

ACE HIGH	Current NATO backbone communications system
ADDS	Army Data Distribution System
AU	Access Unit (MSE)
AUTOKONETZ	New German tactical communications system
BOAR	British Army of the Rhine
CATRIN	New Italian switched communications system
CLANSMAN	New U.K. combat net radio
CNR	Combat Net Radio
ERCS	U.K. ECM Resistant Communications Systems
GRUNDNETZ	German hardened wire connections to PTT system
INTACS	Integrated Tactical Communications Systems
JTIDS	Joint Tactical Information Distribtuion System
LIRSAC	French SCRA candidate
MIDS	Multi-function Information Distribution System
MSC	Mobile Subscriber Central (MSE)
MSE	Mobile Subscriber Equipment
MST	Mobile Subscriber Terminal (MSE)
NICS	NATO Integrated Communication System
PACKET RADIO	Data distribtuion concept based on short data bursts
PLRS PLUS	Advanced Position Location Reporting System
PTARMIGAN	New U.K. Digital Tactical Switched Communication System
PTT	Postal Telephone and Telegraph
RITA	New French switched communications system
SCRA	Single Channel Radio Access
SCTACSAT	Single Channel Tactical Satellite
SINCGARS	Single Channel Ground and Airborne Radio Subsystem
STARRNET	British transmission link from Boar to the U.K.
TACSAT	Tactical Satellite
TRIFFID	New U.K. radio frequency transmission system for PTARMIGAN
ZODIAC	New Netherlands switched communications system

Army Communications Interoperability with NATO Nations

1.0 INTRODUCTION

The MITRE Corporation, Washington C^3 Operations, provides continuing technical support to the Directorate for Battlefield Systems Integration (DBSI), of the U.S. Army Materiel Development and Readiness Command (DARCOM), in the command, control, and communications area. As part of this support, MITRE compared the Army's long range communications plans with those of the land forces of our NATO allies. The purpose of this effort was to determine if there are, or could be in the future, significant interoperability problems between U.S. Army systems and their NATO counterparts.

Interoperability is a term used to assess the effectiveness of an exchange of information, systems, units, or forces among NATO allies. It is a very broad term. With this study, the assessment of interoperability was limited to the technical interoperability (i.e., equipment compatibility) among the NATO tactical communication that are either currently fielded or are planned to be fielded within the next decade. The systems that were reviewed include: tactical switched systems, combat net radios, mobile subscriber systems, tactical satellite communications systems, and the Army Data Distribution System.

The study concludes that, for tactical switched systems, attainable solutions to technical interoperability problems are being implemented either through current interface hardware development or through coordinated planning for future systems. Likewise, for conventional combat net radios, there are no significant technical interoperability problems; however, should SINCGARS be introduced in a frequency hopping mode there may be a problem unless reasonable and attainable solutions are worked out.

The proposed mobile subscriber systems are technically dissimilar in their current planned configurations. Other non-technical considerations, however, such as communications doctrine or national policy currently under review may make it necessary for the mobile subscriber systems of the NATO nations to be compatible from an equipment viewpoint.

Equipment interoperability among tactical satellite communications systems is no problem at the present time and for the near future because the U.S. is the only nation currently developing such systems for imminent fielding. Similarly, there are no equipment interoperability problems with data distribution systems at this time because they are still in the conceptual phase and the U.S. is conducting the main investigation of the concept.

This report is based on technical research, discussions with appropriate U.S. military and civilian personnel, briefings by personnel of the United Kingdom Royal School of Signals, and discussions with U.K. military and civilian personnel. It documents the study and a briefing given to DBSI on 10 October 1978.

Purpose

- Provide Overview of U.S. Army and NATO Nations' Tactical Communications Development Programs
- Assess Communications Equipment Interoperability among These Programs
- Identify Opportunities to Improve Interoperability

1.1 Purpose

The purposes of this report are to:

- Provide background information on tactical communications planning and development within the U.S. Army, key NATO nations and NATO itself.
- Assess the various communications programs and identify significant, potentially problem areas and approaches being taken for their solution.
- Make recommendations for initiatives in Army communications development programs that would improve overall equipment interoperability.

Outline

- Background
- US Tactical Communications Systems
- Interoperability Status and Outlook
  - Switched Systems
  - CNR
  - SCRA/MSE
  - TACSATCOM
  - ADDS
- Conclusions and Recommendations

1.2 Outline

This report begins with a short, historical perspective on the efforts of NATO to achieve greater interoperability and identifies the constraints that inhibit such efforts. An overview of NATO military communications is given along with an identification of the key NATO organizations and national groups that participate in establishing operational requirements and standards for communications equipment.

Current U.S. Army tactical communications systems and planning for the next generation systems are described. Also, the key NATO nations' communications systems that are planned to be in the field by the late 1980's are discussed. A comparison between the next generation U.S. communications systems and analogous systems in the NATO nations is presented.

Next, the individual U.S. systems (i.e., terrestrial switched systems, combat net radios, mobile subscriber equipment, tactical satellite communications, and data distribution systems) are compared with their NATO counterpart systems. This is followed by an assessment of the equipment interoperability between like systems in terms of current status and future outlook.

Conclusions summarizing the findings for each category are presented along with recommendations for interoperability improvements. Appendices for each communications system category contain technical and programmatic details of the various systems and comprise the basis for the interoperability assessment.

Background

- Historical Perspective
- Constraints on Interoperability
- NATO Overview

2.0 BACKGROUND

This section gives a brief historical perspective on the efforts by NATO to improve the interoperability of tactical communications. It discusses the many facets other than technical issues that must be harmonized in order to achieve communications interoperability among the NATO forces. Also, it identifies those organizations within NATO that play a major role in the development of NATO communications standards, and those groups drawn from European nations within NATO that have the strongest voices in establishing communications policy among the European NATO nations.

Historical Perspective

- Independent National Production of Military Equipment Is Preferred
- Many Standardization/Integration Projects during Last Two Decades
- NATO Standardization Agreement (STANAG) Is Historical Tool
- Current Effort Is:
  "Rationalization, Standardization and Interoperability" (RSI)

2.1 Historical Perspective

Every nation needs military equipment to provide for its national security. Generally, nations prefer independent, national production of equipment vital to their national security for military, economic, and political reasons. The re-built defense industries of West Germany, France, Great Britain, Italy, the Netherlands, and Belgium provide these countries with an effective means for procuring this equipment for their own defense as well as a source of income from third world countries seeking military equipment for their own defense needs. This has resulted in the development of military equipment, including communications equipment, designed and built to dissimilar standards among the nations in the NATO Alliance. Conversely, military equipment development in the Warsaw Pact nations is highly standardized and interchangeable among these nations. This imposed standardization has led to conclusions about the probable greater combat effectiveness of Warsaw Pact forces in any future encounters. NATO has long recognized the benefits of standardization among the military equipment of its nations and has tried different ways to achieve it.

In December 1957, at a NATO Summit Meeting, President Eisenhower offered to share U.S. technical knowledge, and experience in arms production to assist joint European weapons production. In response to this, the NATO heads of government agreed that better use of the Alliance's resources would be obtained through a high degree of standardization and integration. Many cooperative projects grew out of this initiative. However, when the U.S. talked about standardization the European interpretation was that the U.S. was again trying to sell one of its weapon systems. This interpretation, plus the unwillingness of the U.S. to purchase European weapon

systems became a source of irritation for the Europeans.* The roots of the current European efforts to gain a larger portion of military equipment sales to the NATO nations (i.e., the "two-way street") may go back to this period.

The various cooperative projects developed different tools to coordinate and promote standardization throughout the NATO bodies. One tool, the Standardization Agreement (STANAG) has had some limited success in promoting low-level standardization among weapon systems. The STANAG procedure offers a forum and method for the establishment of common technical standards for participating nations. Good progress has been achieved in developing communications equipment standards that allow the interconnection of existing systems and equipment that will be in the field through the mid 1990's. However, the goal of achieving commonality in military communication equipment has not yet been reached. Overall, the efforts by NATO nations to improve the standardization and integration of their weapon systems has not been very successful. The need to improve this situation is reflected in the current U.S. emphasis on "Rationalization, Standardization and Interoperability," better known as "RSI," as well as in President Carter's and Secretary Brown's calls for increased cooperation among the NATO allies in the procurement and development of weapons and C^3 systems.

This report is focused on an assessment of the "Interoperability" of Army Communications systems with those of our European NATO allies. It specifically addresses the hardware interoperability among diverse types of communications equipment currently under development or planned by the NATO allies for their tactical forces.

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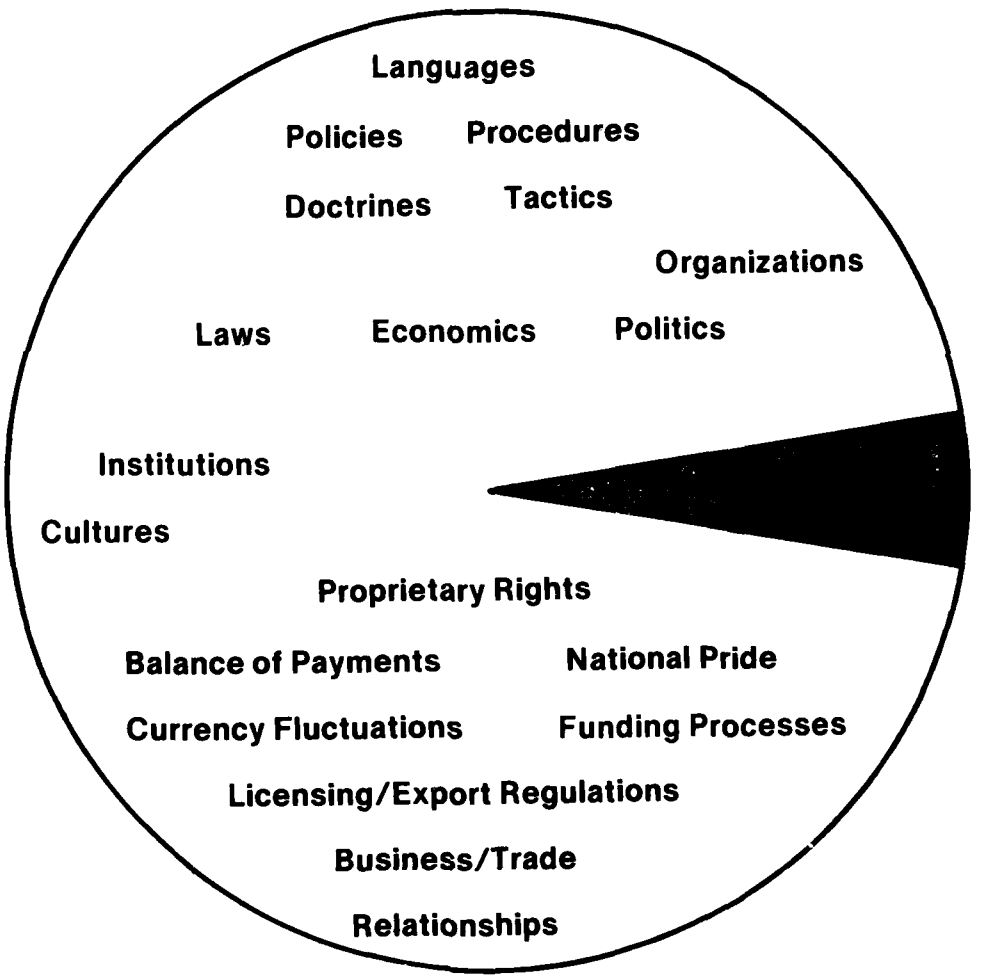
*NATO STANDARDIZATION: Political, Economic, and Military Issues for Congress, a report to the Committee of International relations, House of Representatives, Congressional Research Service, Library of Congress, USGPO 86-024, March 29, 1977, 10-11.

Constraints on Interoperability



2.2 Constraints on Interoperability

Achieving military systems interoperability encompasses much more than simply enabling similar equipment of two or more countries to "talk" to each other. The end product of the military communications equipment procurement chain, the hardware, is the result of a long sequence of decisions made by military and civilian powers within the national government procuring the hardware. Considerations relating not only to technical constraints but to proprietary rights, funding processes, legal/economic/political limitations, licensing/export regulations, business/trade relationships, national pride, etc. affect who will make the hardware, what standards it will conform to, and when it will be available. These factors in turn have a strong impact on the ability of the communications hardware to operate with similar communications hardware fielded by other nations in the Alliance. Even if full hardware interoperability between two nations is assumed, interoperability as defined by DoD and NATO still may not be achieved because of differences in military organizations, doctrine, tactics, policy, procedures, or because of national security constraints, or most significantly, because of a language barrier.

The classical way to overcome the differences in language and military procedure, organization, tactics, etc. has been to send liaison teams to the headquarters of adjacent army units. These teams are specially trained in the language, tactics, procedures, organization, etc. of both armies and provide an effective way to transmit the thinking and intent of one commander to another commander. The liaison team is one way to obtain working communications interoperability given the differences cited above, although it is sometimes criticized by field commanders as ineffective because of the poor quality of the officers assigned to these teams.

The changes required to achieve total communications interoperability among NATO military forces are evolving, albeit slowly. Achieving technical interoperability of the NATO nation's military communications hardware is a necessary but far from sufficient requirement to obtain communications interoperability among NATO nations. It is the status of this technical interoperability that is the subject of this report.

NATO Involvement in Military Communications Electronics Equipment

- Coordinate Development of New Equipment
- Develop Consensus on Operational Requirements
- Develop NATO Command Structure Communications
  - NATO Forces (In-Place)
  - NATO Integrated Communications System (NICS)

2.3 NATO OVERVIEW

2.3.1 NATO Involvement with Military Communications Electronics Equipment

Every NATO nation with land forces in Europe requires communications interoperability with the land forces of other NATO nations that will be deployed on its flanks or operating within its assigned area. Until now the Armies of the Alliance have relied on three basic types of electronic communications: net radio, teletype, and switched systems, the latter including both wire radio transmission links. Analog modulation has been standard for voice traffic. Changes are taking place that will see a shift from analog to digital architectures for voice, message and data traffic in military systems. Requirements to provide service for digital data traffic at lower echelons are growing and military tactical satellite systems are being developed.

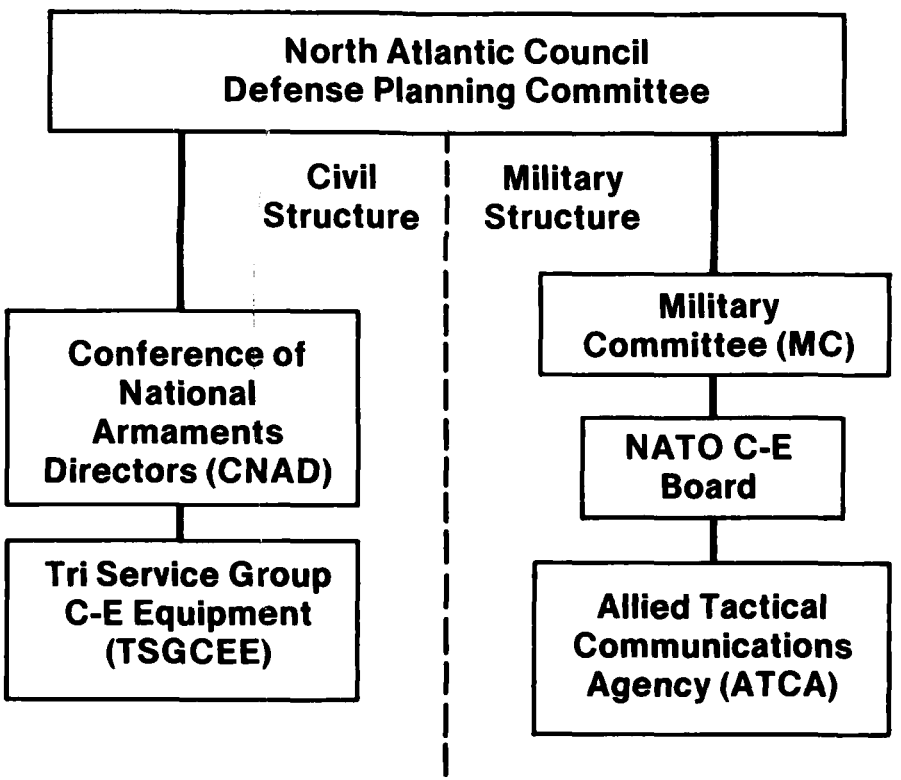
NATO has recognized the need to coordinate this development but it does not have the authority to direct any NATO nation to equip that nation's forces with specific items of equipment. It does attempt to develop a consensus among the nations as to the operational requirements that define equipment characteristics, and to guide development of standards that will facilitate communications equipment interoperability. When these efforts are successful, the results are promulgated through STANAGS.

The NATO command structure must have communications interoperability at high command levels within the armies of the Alliance both during peace time and when at war. This will be accomplished through communication interfaces between NATO and the switched systems of each NATO nation. The NATO command structure also requires communications interoperability with NATO forces (in-place) that are under NATO control during peace time. For these forces, this interface will be through net radio at the forward echelons and through the switched systems at the rear.

With regard to equipment to be used by NATO forces (in-place), NATO has the authority to: establish policy for military standardization, develop plans and requirements, support R&D, and develop and procure the equipment. In providing for their forces-in-place, the NATO procurement agency must also consider communications interoperability of the NATO equipment with that of the other NATO countries. At the present time, these forces are mainly drawn from and associated with Air Force activities. Communications interoperability requirements between the Army and the NATO forces-in-place currently are not significant.

NATO's requirement for communications interoperability at high command levels within the Armies of the Alliance provides it with the authority to develop the communications links between these Armies and the NATO command structure. Existing communication links use the ACE HIGH system as a backbone transmission link. This will be replaced by the NATO Integrated Communications System (NICS). NICS is planned as an automatically switched, common user grid network. It will use a wide range of communications equipment including satellite, terrestrial radio, and cable systems to provide connections into the switched network from mobile and isolated users as well as from those at fixed locations. Up to 20 large NATO satellite communications ground terminals are planned, along with radio relay and troposcatter systems, to provide improved communications interoperability between NATO and national civil and military strategic and tactical systems. The NICS system design, development, and procurement is being managed by Integrated Communications System Management Agency (NICSMA).

Key NATO Organizations Involved

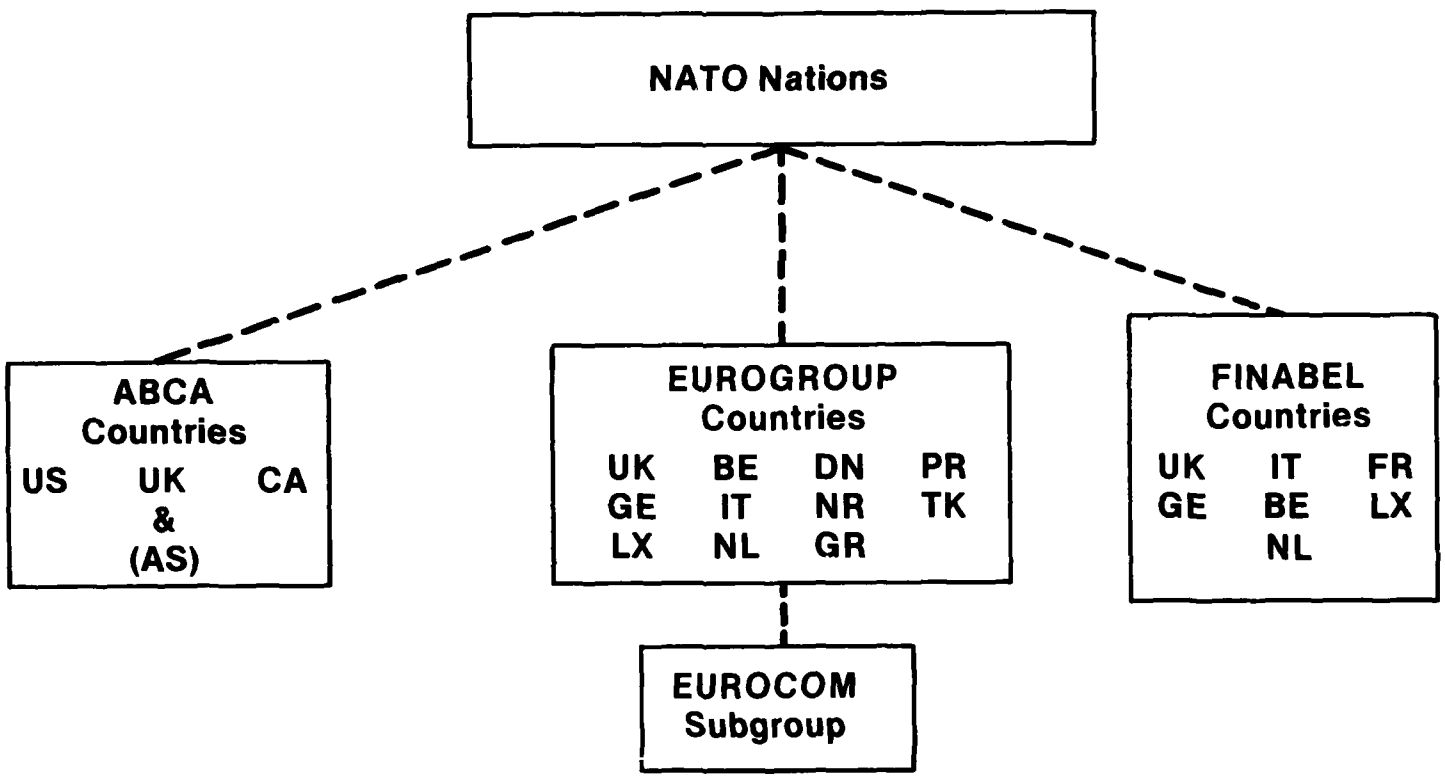


2.3.2 Key NATO Organizations Involved

The key NATO organizations involved in the development of a STANAG* for tactical military communications are shown on this chart. The Allied Tactical Communications Agency (ATCA) is the primary agency concerned with the development of operational requirements and STANAGS within the military structure of the Defense Planning Committee of the North Atlantic Council. The ATCA is a part of the NATO Communications Electronic Board which reports through the Military Committee (MC). The Conference of National Armaments Directors (CNAD) approved the formation of the Tri-Service Group on communications electronics equipment (TSGCEE) in June 1977. The TSGCEE combines the functions performed by several former CNAD bodies and provides a focal point within the civil structure of NATO to resolve interoperability problems related to tactical communications, ECM-resistant data communications, identification, and navigation areas.

*Standardization Agreement

National Groups Influencing NATO Communications



2.3.3 National Groups Influencing NATO Communications

Several groups of nations have come together since the 1960's with the goal of influencing tactical communications developments within the NATO alliance. The EUROCOM Subgroup of the Eurogroup countries currently is the key group influencing tactical communications standards among the NATO countries. The EUROCOM charter is aimed at promoting interoperability between the tactical communications systems of the land forces of the Eurogroup nations. At the present time, the Eurogroup includes all countries in the North Atlantic Treaty Organization with the exception of Iceland, France, Canada, and the United States. The EUROCOM Subgroup has been particularly busy in obtaining consensus on the standards to be applied to the tactical switched networks. The U.S. does not participate directly in the activities of the EUROCOM Subgroup. However, the formation in October 1976 of a US/EUROCOM Working Party provides the U.S. with a formal means to present its view to the EUROCOM Subgroup.

The ABCA* countries, comprised of the U.S., U.K., Canada, and Australia, maintain working groups on combat communications. These groups meet periodically to discuss ways in which the interoperability of the communications equipments of these countries can be improved. The ABCA working group on combat communications has ongoing programs to achieve standardization of tactical communications systems. Highest priority is given to achieving interoperability between TRI-TAC and PTARMIGAN. The efforts of the EUROCOM Subgroup have been followed and included in the considerations of the ABCA Working Group to prevent duplication of work. The ABCA Working Group has achieved technical agreements which will allow the U.S. and the U.K. combat net radio security equipment (VINSON and LAMBERTON) to interoperate.

*America, Britain, Canada, Australia.

A separate group of European countries known as the FINABEL* countries have in the past worked together to harmonize the communications interfaces between the equipment of these countries. However, recent efforts of the FINABEL group appear to have gained little support from the Eurogroup countries.

*France, Italy, Netherlands, Belgium, England, Luxembourg (and Germany).

US/NATO Communications Systems

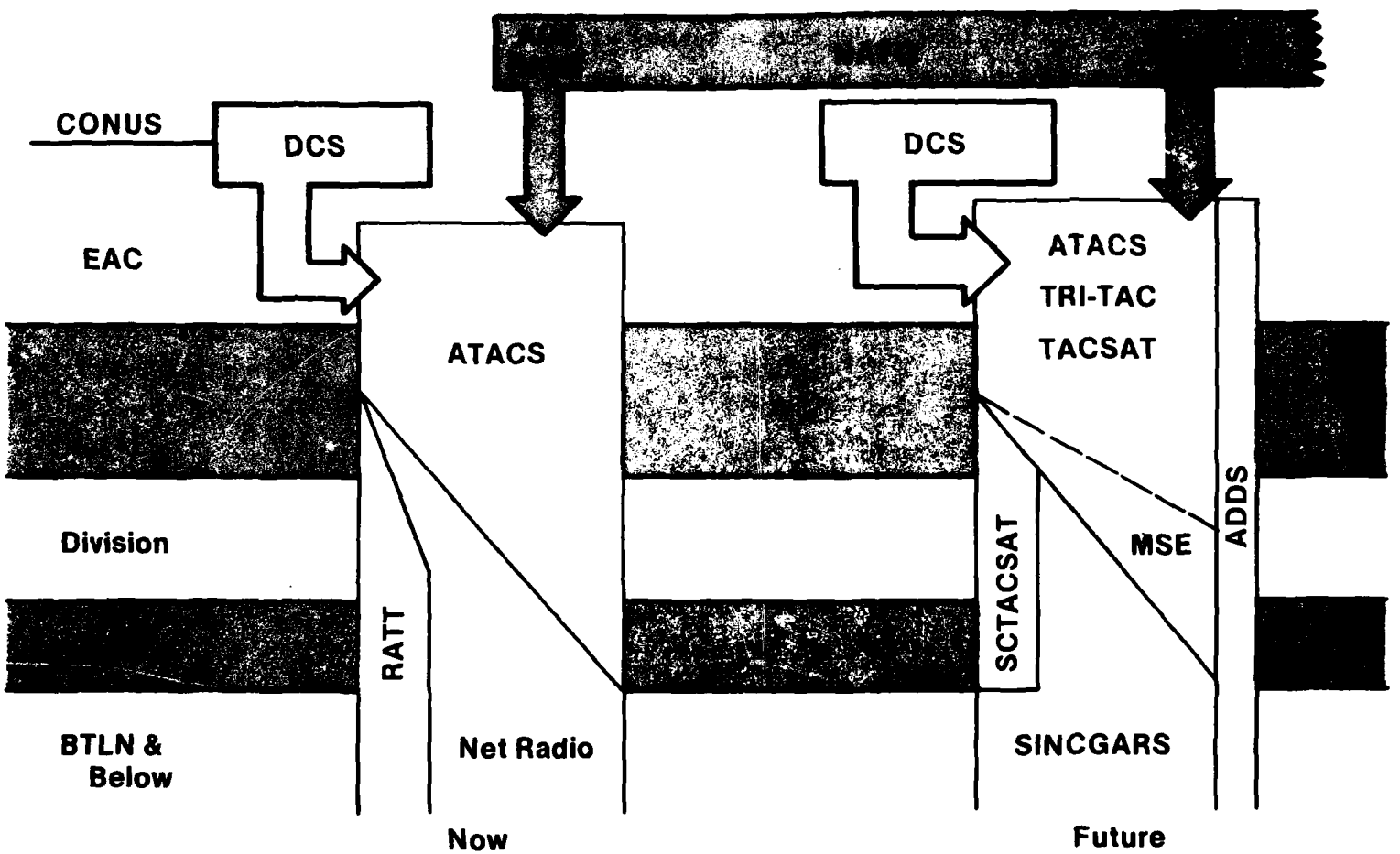
- US Army Communications in NATO Arena
- Future NATO Communications Systems

3.0 NATO COUNTRIES COMMUNICATIONS SYSTEMS

This section provides a brief description of how the current U.S. Army Communications Systems are deployed within the NATO arena. The changes in their deployment (by echelon) that are called for by the INTACS* "Objective System" concept are also discussed. The U.S Objective System communications are then compared echelon by echelon with the counterpart communications systems of other NATO countries. Brief descriptions of the communications systems of the other NATO countries are also given.

*The Integrated Tactical Communications System is the Army's long range plan for improving and evolving its tactical communications capabilities through 1990. This plan is currently being updated and changes in the Objective System should be anticipated.

US Army Communications in NATO Arena



3.1 U.S. Army Communications in the NATO Arena

This chart shows the general breakout of current and planned Army communications equipment* as structured for deployment in Europe. The future deployment is based on the INTACS Objective System concept with the addition of the Army Data Distribution System (ADDS). The INTACS study is currently being updated and changes to the Objective System concept may occur.

The present Army area communications system is comprised of Army Tactical Communications Systems (ATACS) equipment that is in place from echelons above corps down through brigade. In the corps area and above, the major equipment consists of circuit switches of the AN/TTC-25 and AN/TTC-38 variety and high capacity multichannel radio trunk-links. The area system has an extension node into the division rear area. From division down to brigade the ATACS equipment consists of medium capacity multichannel equipment (e.g., AN/TRC-145) and manual switchboard telephone systems. Combat net radio (CNR) equipment of the AN/PRC-25 and AN/VRC-12 families are found predominantly at brigade and below. CNR provides the major means of mobile communication for the land forces in the forward area. The present High-Frequency Radio Teletype (HF-RATT) net provides the record traffic function from below battalion back through the corps area. Communication back to CONUS is accomplished primarily through connections to the DCS system in the corps area.

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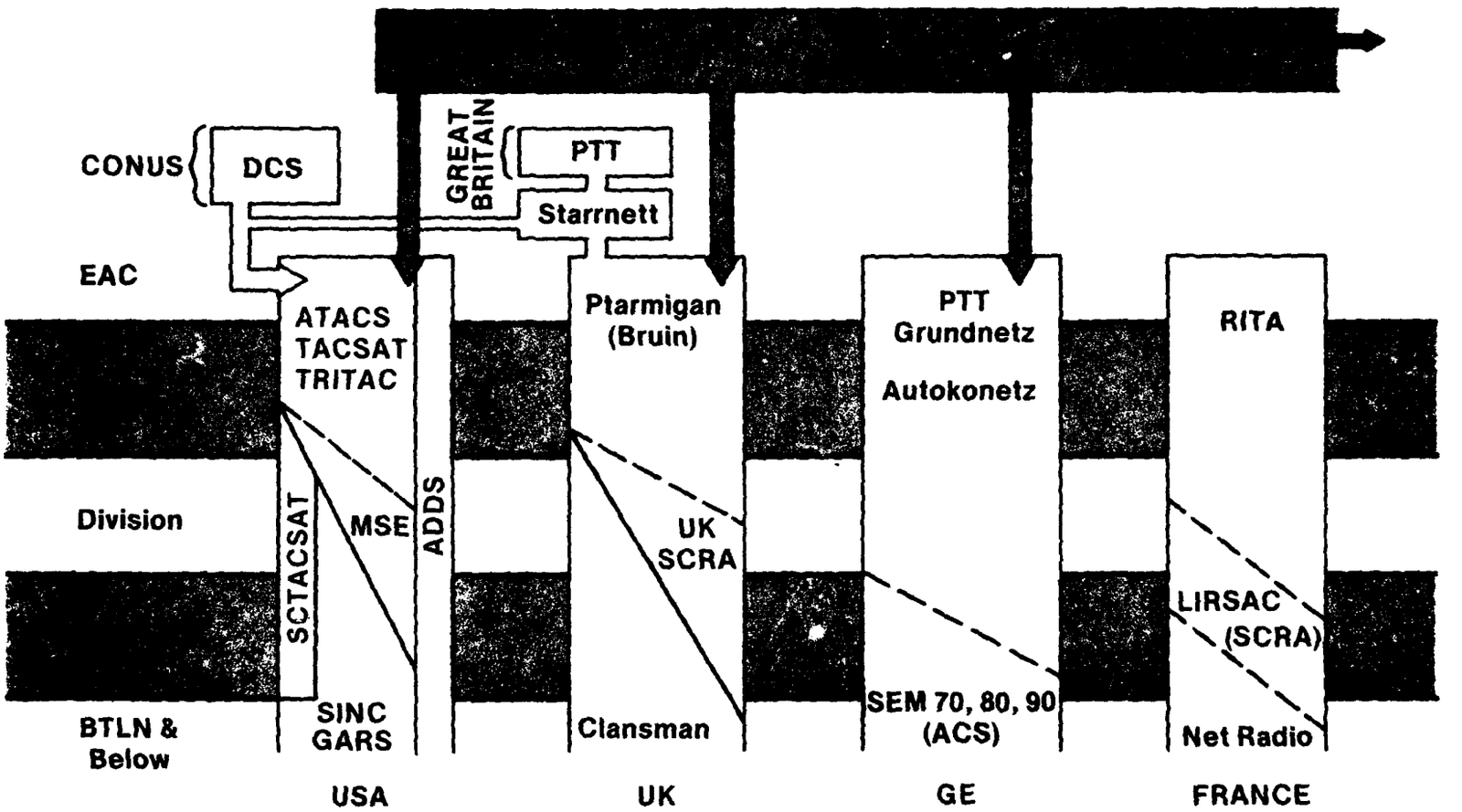
*See the two Department of the Army publications listed in the Bibliography for detailed information about current equipment.

In the future deployment, the area communications system will be comprised of TRI-TAC AN/TTC-39 circuit switches and AN/TYC message switches* as well as ATACS equipment. Single Channel Tactical Satellite Communication (SCTACSAT) links will replace the HF-RATT nets from corps down to brigade. Multichannel Tactical Satellite (TACSAT) communications links will augment communications from brigade to division to corps and above. The Mobile Subscriber Equipment (MSE)* is planned primarily in the division area between division headquarters and brigade. The Army Data Distribution System may be found at all echelons depending on how ADDS requirements evolve; there may be greater use at forward echelons. In the future communications mix, the majority of communications at brigade and below will use the new combat net radio SINCGARS.** The HF-RATT net will be replaced by a combination of SINCGARS radio and Single Channel Tactical Satellite (SCTACSAT).

*TRI-TAC and MSE are covered in MITRE Technical Reports (MTR) 7669 and 7890 by William F. de Dufour. See the Bibliography for the full citation for each report.

**Single Channel Ground and Airborne Radio Subsystem.

Future NATO Communications Systems



3.2 Future NATO Communications Systems

This chart shows the different families of communications equipment that are likely to be in place in Europe during the middle to late 1980's. The equipment breakout by echelon for the U.S. is the same as the breakout previously shown for future U.S. Army communications.

The U.K. anticipates having their digital area switched system (PTARMIGAN) fielded in the British Army of the Rhine (BAOR) area of Germany as a replacement for the BRUIN system by the mid 1980's. The U.K. also plans to field the U.K.-SCRA* mobile subscriber service as well as the CLANSMAN radio family to replace their current combat net radios. The U.K. maintains a communications link back to the British Islands called STARRNETT. STARRNETT will continue to be in place through the 1980's; however, it is considered by the British to be a peace-time only system. STARRNETT interfaces with the British Postal Telephone and Telegraph (PTT) system in Great Britain. The U.S. DCS system and the U.K. STARRNETT system are linked together.

The main German tactical communications system will be the AUTOKONETZ system, an analog system designed to be compatible with the German PTT network. In addition, the Germans also have in place an austere hardened communications network, the GRUNDNETZ, which also interfaces with the German PTT. By the mid 1980's, the Germans will have fielded the SEM-70, 80, 90 series of combat net radios that may have an automatic channel selection (ACS) feature. The Germans have indicated a desire to include some type of SCRA system in their tactical communications makeup; however, the name for this system has not been determined. It is likely that the German SCRA concept will be used at battalion or below.

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*Single Channel Radio Access

The French are completing development of the RITA system, an analog system that will be in place in the early 1980's. Neither RITA or AUTOKONETZ are directly interoperable with the digital TRI-TAC and PTARMIGAN systems. Efforts are currently underway to resolve interface problems between these two systems and it is likely that some interface concept, either a single channel or trunk group approach will be worked out. The French are working on their own SCRA system identified as LIRSAC. It is estimated that the LIRSAC equipment will be used primarily in support of brigade communications. The only identified change in the French CNR equipment is the production of the TRVP-113 radio which should be in place by the mid 1980's.

Belgium has indicated that it will purchase RITA switches for inclusion in its area system to be fielded in the early 1980's. They do not plan to use the LIRSAC SCRA. It is not known whether the Belgian trunk system will be compatible with the RITA trunk system or with other EUROCOM systems in this time frame. Italy is developing the CATRIN area switched system that will be compatible with EUROCOM standards and will include EUROCOM standard SCRA equipment. The Netherlands will replace their current area switched system, the INTERIM system, in the mid-to-late 1980's with their new area switched system called ZODIAC. The ZODIAC system will be compatible with the EUROCOM standards.

The NATO Integrated Communications System (NICS) will interface at corps or echelon above corps with the U.S. Army, the Armies of Germany and France, and the other NATO nations.

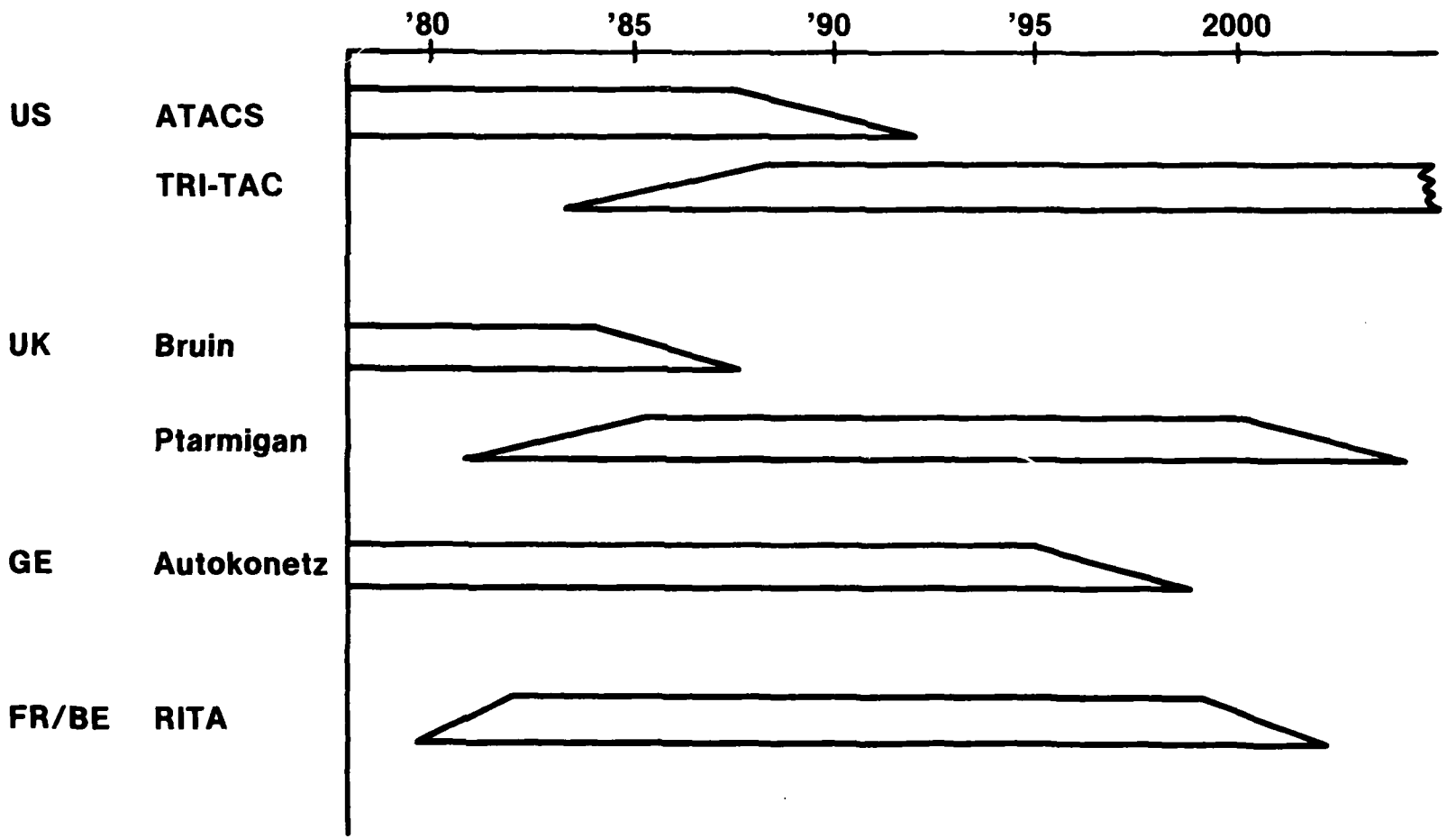
Interoperability Status and Outlook

- Switched Systems
- Combat Net Radio
- Mobile Subscriber Concepts
- TACSATCOM
- ADDS

4.0 INTEROPERABILITY STATUS AND OUTLOOK

This section provides an assessment of the interoperability status between U.S. communications systems and those of our European NATO allies. The systems that have been analyzed include: switched systems, combat net radios, mobile subscriber concepts, tactical satellite communications systems, and the Army data distribution system. The outlook for improvements in equipment interoperability between the U.S. systems and the NATO systems is given.

Estimated Schedules
Tactical Switched Systems



4.1 Switched Systems

4.1.1 Estimated Schedules

The estimated schedules for introduction of the new generation tactical switched systems and phasing-out of current systems are shown in the accompanying chart. The U.S. ATACS analog switched system will be in the field through the late 1980's. The next generation switched system, built around the AN/TTC-39 hybrid communications switch, will be fielded during the mid 1980's. This switch will allow for concurrent use of ATACS analog equipment with TRI-TAC digital architecture. The early AN/TTC-39 switches are likely to include significant analog switching capabilities. Transition to a mainly digital system will occur by the early 1990's.

BRUIN, the current U.K. tactical switched system is deployed with the British Army of the Rhine (BOAR). The British PTARMIGAN system, sucessor to BRUIN, is scheduled to be introduced to the BOAR in 1983. Rather than fielding PTARMIGAN as a gradual replacement for elements of BRUIN, the U.K. has elected to make the change-over to PTARMIGAN within a matter of a few days once sufficient equipment has been built and adequate training has been achieved.

AUTOKONETZ, the current German tactical switched system, has recently been introduced into the field. It is an analog system that uses digitally controlled mechanical switches and was designed to be fully compatible with and to extend the life of the existing German PTT equipment. For economic reasons the Germans probably will extend its useful life through the mid 1990's.

RITA, the French tactical switched system, will become operational in the early 1980's. This system will allow continued use of existing analog subscriber instruments with the new digitally controlled analog switching concepts. It will be directly compatible with the Belgian switched system, which uses the RITA switches, but not with the systems planned by the other NATO countries.

The Netherlands and Italy also are planning to upgrade their area tactical switched networks. The ZODIAC system will replace the Netherlands current INTERIM system sometime after 1985. Italy's advanced tactical switched network, CATRIN, is scheduled to be fielded after 1985. Both ZODIAC and CATRIN are planned to be compatible with EUROCOM standards.

Appendix B contains more information on these switched systems.

Switched Systems Interoperability

- STANAG 5040 Defines Interface for Analog Systems
- EUROCOM/TSGCEE Developing Interface Standards for Digital Systems
- TRI-TAC Switch (TTC-39) Being Modified To Be Compatible with EUROCOM/TSGCEE Standards
- Inter-Network Access Will Be between Switches:
  - Single Channel to Single Channel for Analog Systems
  - Trunkgroup to Trunkgroup for Digital Systems
  - Some Secure-Voice Trunkgroup Links Will Be Available
- Switched Systems Interface Concepts Appear Reasonable and Attainable

4.1.2 Switched Systems Interoperability

Significant progress has been made towards achieving communications hardware interoperability among tactical switched networks by those nations involved in developing STANAG 5040. This STANAG defines the interface standards that will allow the tactical systems of the U.S., U.K., Germany, France, and other European nations to interconnect between systems on a channel by channel basis. STANAG 5040 defines a NATO Interface Device (NID) that converts the signalling of each nation's system to a common NATO standard. It has been implemented in a device called the D-55 Interface Box. Since each country converts its own signals to a common standard, connections can be made between systems on a single channel basis where this device is used. Fully automatic and semi-automatic prototype hardware of the D-55 box has been built and tested successfully.

Interface standards for the forthcoming digital systems are being developed by EUROCOM in coordination with the NATO Tri-Service Group on Communications Electronics Equipment (TSGCEE). These digital interface standards will provide adequate inter-network connections at the trunk group level for the digital switched systems being fielded in the 1980's.

The AN/TTC-39 communications switch is being modified to be compatible with the STANAG 5040 standards and will conform to the proposed EUROCOM/TSGCEE standards. Additional information on these interface concepts is provided in Appendix C.

The German AUTOKONETZ and the French RITA analog systems will co-exist with the digital systems through the 1990's. Efforts are underway to develop acceptable interface standards between RITA, AUTOKONETZ and the forthcoming digital systems. Tactical systems to be fielded by other NATO nations after the late 80's will conform to EUROCOM/TSGCEE standards.

In summary, there will be inter-network access between both the current analog tactical area systems and the proposed digital tactical area systems. Agreement has been reached to provide for a single channel to single channel interface concept for the existing analog systems and to provide for trunk group compatibility between the proposed digital systems. Also, some secure-voice trunk-group links will be available when the digital systems are introduced.

Outlook
Switched Systems

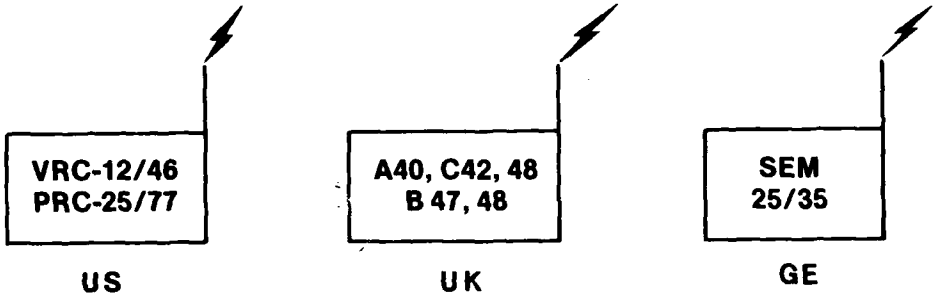
- **Each Nation Will Control Access to Its Own Network**
- **Inter-network Voice and Data Capacity Requirements To Be Resolved**
- **Implementation of Standardization/Rationalization Solutions Prior to Late '90's Is Unlikely**

4.1.3 Outlook Switched Systems

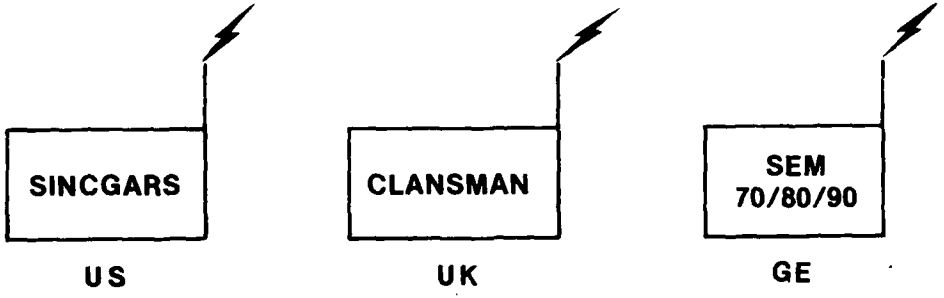
As we have seen, the outlook for equipment interoperability between the tactical switched networks of the NATO nations is good. The D-55 Interface Box will provide access between the analog networks that will be in place through the mid 1980's; preliminary agreement has been reached that will allow these digital networks to interface at the trunk group level. However, the operational requirements that will define the number and location of these inter-network voice and data interfaces still need to be resolved. Effort is underway to determine the traffic capacity requirements between the U.S. and German networks and between the U.S. and U.K. networks.

The sunk costs of the various tactical switched networks represent a sizeable economic investment for the individual NATO nations. Furthermore, the nations, in most instances have initiated advanced/engineering development of the next generation of digital systems. Standardization of tactical switched systems now would require a write-off of some of these costs and would be extremely difficult to achieve. Because of this, it is unlikely that a standard NATO-wide to tactical switched network could be achieved before the late 1990's.

NATO
VHF Combat Net Radios



1978



1985-1990

4.2 Combat Net Radios

4.2.1 Modernization Programs

The VHF-FM combat net radios for the NATO nations provide the mainstay of communications in the forward battle area. The U.S., the U.K., and the Federal Republic of Germany are in the process of modernizing their VHF-FM combat net radios. The U.S. is developing the SINCGARS family of net radios to replace the current series of radios. These radios will have the capability to transmit either analog or digital voice signals and will use the frequency hopping spread spectrum technique for electronic warfare protection.

The U.K. has begun production of a new series of radios called CLANSMAN. CLANSMAN will use analog voice modulation techniques and will replace all existing CNR's in Europe by 1983.

The Federal Republic of Germany is in the process of updating their current combat net radios (SEM 25/35 series) to a more advanced radio, the SEM 70/80/90 series. These new German radios will have the capability to transmit either analog or digital voice signals and may include an Automatic Channel Selection (ACS) feature that allow the radios to select a different vacant channel within an assigned bundle of frequencies each time a transmission is made. This feature plus the inclusion of a digital net identification code allows a net to come up on different frequencies each time the net is activated. The SEM 70/80/90 series of equipment is scheduled to be in the field during the early 1980's.

Other NATO nations are pursuing less ambitious development programs for their combat net radio equipment. Appendix D provides more details on each nation's combat net radio equipment.

VHF Net Radio Interoperability

- Good Net Radio Equipment Interoperability Now
- NATO Making Progress on Standards
- US/UK Secure Voice Capability
- US Leads in Development of ECCM Capability

4.2.2 Net Radio Interoperability

There is good equipment interoperability now among the current generation of NATO combat net radios. Sufficient standardization of center frequencies, bandwidths, analog modulation techniques, etc. has already taken place to provide workable, non-secure links between the different combat net radios. A high degree frequency overlap exists among the radios. However, this overlap is limited by agreements among the NATO countries that allocate dissimilar portions of the VHF spectrum to military use within different countries. The available non-military VHF spectrum in Europe is crowded with public service and government related users. Mutual agreement among the NATO countries to displace these existing services would be needed to obtain more military VHF spectrum overlap.

The NATO TSGCEE is making progress towards the development of three combat net radio standards. One, the NATO RF standard, is close to being promulgated and implementation is already evident in some equipment. The NATO standard on secure voice techniques will be agreed upon within a year or two. The NATO standard on ECCM have not yet been defined.

The U.S. and the U.K. have agreed to standards that will allow the VINSON and LAMBERTON communication security devices to interoperate. This will permit secure voice CNR communications between the U.S. and the U.K.

In the ECCM area, SINCGARS is the only development program that includes an ECCM requirement. The U.K. proposes to take a look at an ECCM add-on or retrofit for CLANSMAN after the radios are fielded in 1983, while the Federal Republic of Germany has proposed a joint development with the U.S. of an ECCM module for qualification in the SINCGARS "fly-off." At this time it appears that the U.S. has the lead in shaping the development of NATO ECCM standards.

SINCGARS in the analog mode will be interoperable with both the current U.S. VRC-12 radios and NATO radios. However, in the ECCM (frequency hopping) mode, SINCGARS will not be interoperable with any other existing or planned NATO radio.

Outlook
VHF Net Radio

- Additional RF Tuning Range Overlap among NATO Countries Is Unlikely
- Increased Secure Voice Capability Forthcoming
- US Has Opportunity to Lead Development of a Common NATO ECCM Approach

4.2.3 Outlook Net Radio

CNR operation between the U.S. and NATO forces will be constrained by the existing frequency overlap which was previously described. It is unlikely that additional tuning range overlap can be achieved because of the many political constraints already discussed.

Operational effectiveness among NATO radios at those frequencies that do overlap will be enhanced when NATO secure voice standards are promulgated. The U.S. and the U.K. have started to implement the changes required to give their analog CNR radios a secure voice equipment interoperability capability.

The SINCGARS frequency hopping mode represents a significant technical change in CNR. This mode of operation will not be backward compatible with any NATO nation CNR including our own. The U.S. lead in this technique represents an opportunity to guide development of a common NATO ECCM approach for CNR. By supporting a common or at least a compatible ECCM approach, the Army would make a significant contribution towards continued and improved equipment interoperability among NATO net radios.

Mobile Subscriber
Radio Telephone Concepts

- Frees User from Field Wire Dependence
- Different Concepts Espoused by US, UK, FR, & GE
- No Agreement on Operational Requirements
- NATO Ministers Have Called for Cooperative Development

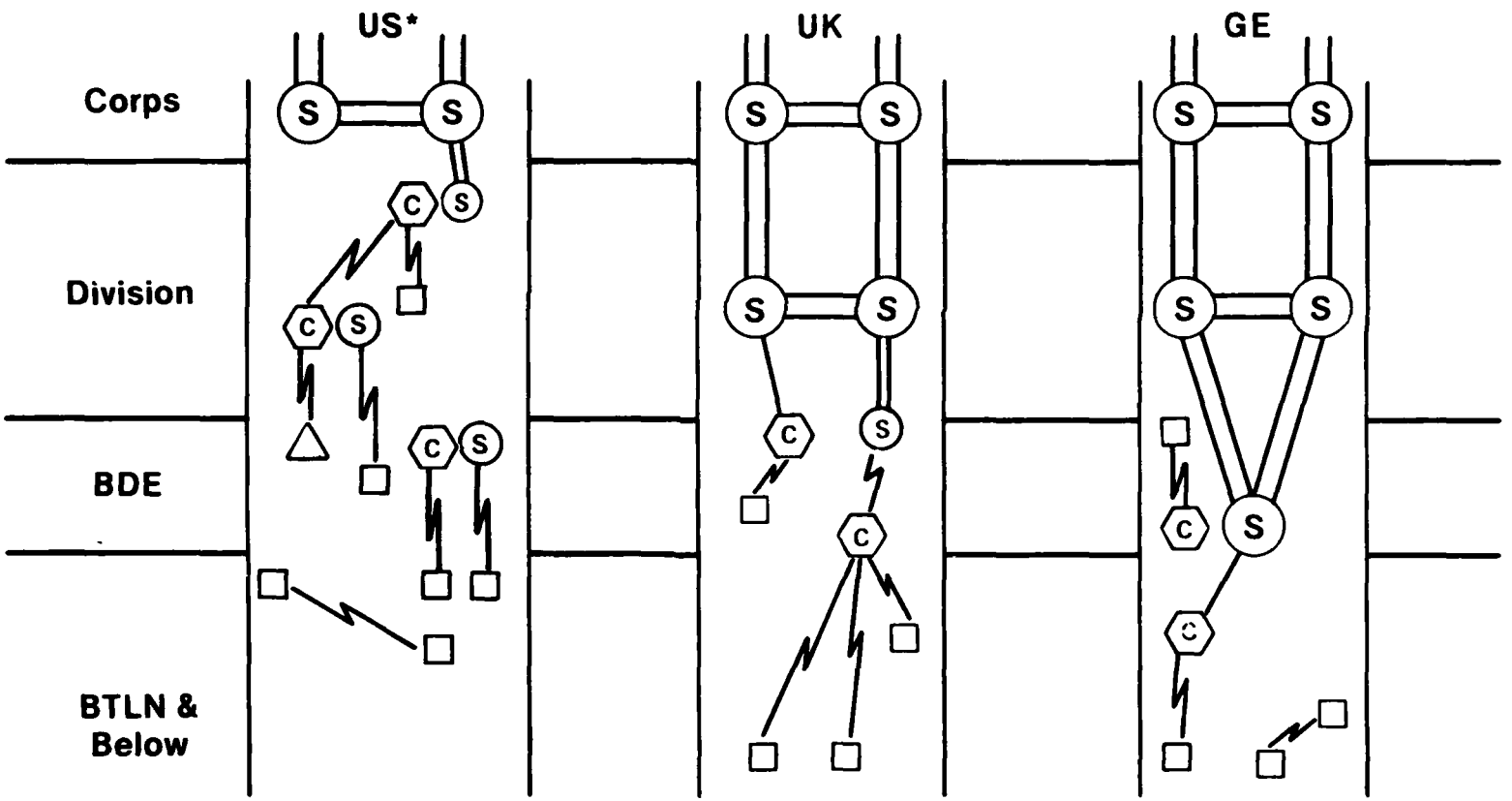
4.3 Mobile Subscriber Radio Telephone Concepts

The communications planning of several NATO nations has included for many years dial-up radio telephone concepts that would provide service to selected mobile subscribers and free the military user from dependence on field wire. The U.S. approach to this concept, embodied in the TRI-TAC Mobile Subscriber Equipment (MSE), is scheduled to enter the concept validation phase by mid 1979. The development of this concept in the U.K. has already reached the hardware stage with the PTARMIGAN Single Channel Radio Access (SCRA) dial-up mobile subscriber equipment. This equipment is scheduled to be field tested by the U.K. military starting in the latter part of 1979. The Germans are exploring the possibility of providing for the mobile subscriber by adapting their SEM 70/80/90 net radio Automatic Channel Selection (ACS) feature for this purpose. The French are developing LIRSAC, the mobile subscriber equipment subsystem of the RITA switched system. As envisioned now, none of these concepts are directly interoperable.

While development of these concepts has been underway in each country, the EUROCOM SCRA working group is continuing to try to obtain agreement among its members on a common definition of operational requirements for a mobile subscriber system. It should be noted that the terminology Single Channel Radio Access or SCRA when used by EUROCOM or NATO relates to a generic mobile subscriber system and, at this time, does not equate to the U.K. PTARMIGAN SCRA concept.

General agreement exists among the NATO countries regarding a need to provide dial-up radio telephone service to ground forces. However, operational requirements for this service vary widely among the countries and agreement on common operational requirements among the countries has not been achieved. At the Spring 1978 meeting, the NATO ministers indicated support for an early resolution of the operational requirements issue and called for cooperative development in this area. For these reasons, mobile subscriber concepts and the differences in philosophy and approach among the nations will be described in more detail than for the other communications systems.

NATO
Mobile Subscriber Concepts



*TRI-TAC/Objective System Concept

S Switch □ Mobile Subscriber

C Central △ Access Unit

4.3.1 Radio Telephone Implementation Concepts

The differences between the U.S., U.K., and German mobile subscriber radio access concepts are illustrated on this chart. The Mobile Subscriber Equipment (MSE) concept is a TRI-TAC development program originally defined as a key element of the INTACS Objective System. The U.K. will provide service for their mobile subscribers through the PTARMIGAN Single Channel Radio Access (U.K.-SCRA) equipment. The Germans are considering a single channel radio access concept that will interface with their PTT system. Other NATO countries are also interested in developing single channel radio access capability to provide for mobile subscribers within each army.

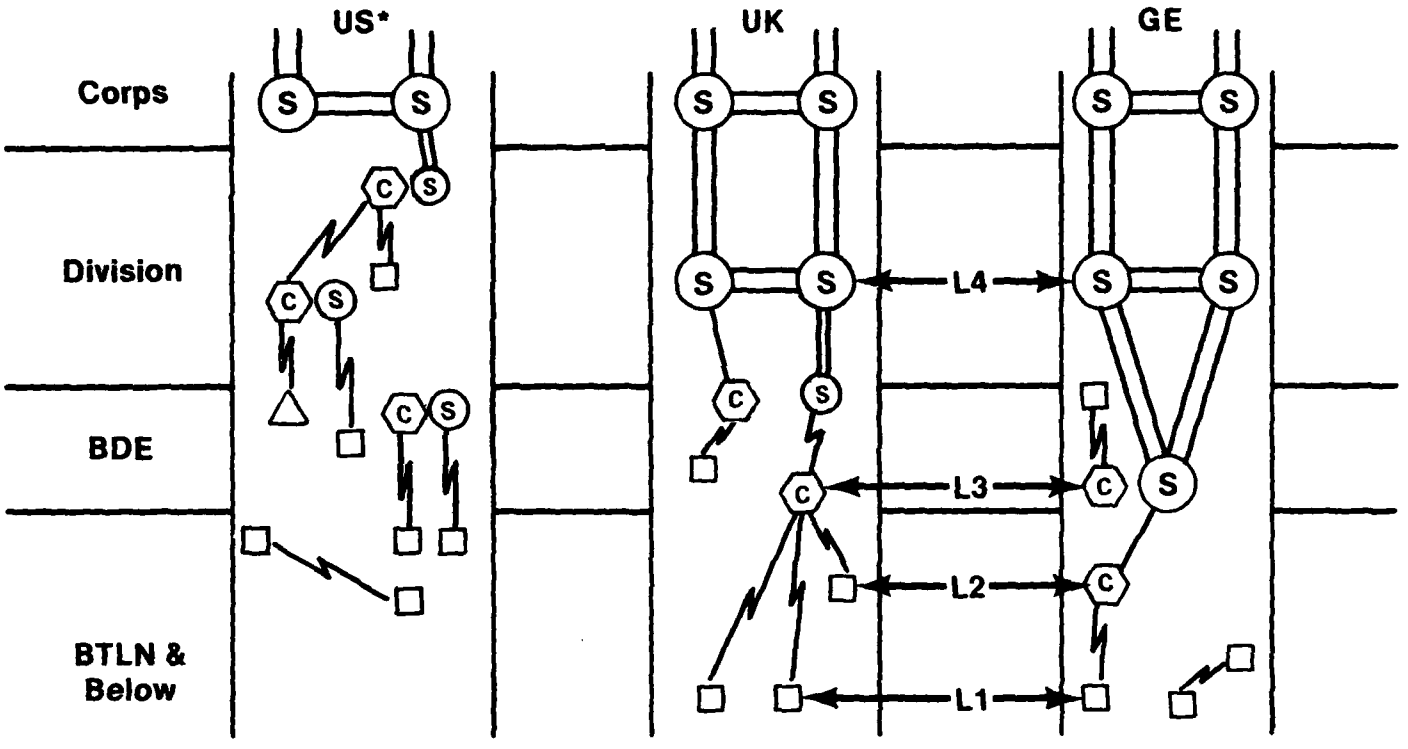
The U.S. MSE concept is comprised of three major elements: the Mobile Subscriber Central (MSC), Mobile Subscriber Terminal (MST), and the Access Unit (AU). These elements are combined in the Objective System MSE concept to perform two functions in the division and brigade area; first, they serve as a replacement for the current AN/TRC-145 multi-channel links between division and brigade; second, they provide a mobile subscriber with radio-telephone service to other local mobile subscribers and with access to the MSE network. In this concept the MSTs are the direct-dial terminals assigned to the mobile subscribers. MSCs provide the normal control/supervision functions that allow local MSTs to establish contact and operate in a secure mode. The MSCs also may be used in a range extension function to allow one MST to contact a more distant MST. In addition, the MSC may establish communications either through another MSC to a distant MST or to the area switched system. This concept requires that an MST also have the capability to talk directly to another MST or AU without the intervention of an MSC. The AUs serve to connect small switchboards associated with command posts to the MSE network. System supervision, routing instructions, crypto-keying , etc. for the MSE will be provided by extensions of the corps area tactical communications control facility (TCCF). Call processing, switching and call routing will be performed by a modified AN/TTC-42 collocated with each MSC.

The United Kingdom PTARMIGAN SCRA concept was conceived as a downward extension of the area switched system. To this extent, the PTARMIGAN switches are carried well down in the division area. The SCRA terminals assigned to the mobile subscribers provide the direct-dial function similar to the MSTs. The SCRA centrals provide the control/supervision functions for the SCRA terminals. The SCRA terminals and the SCRA centrals are interconnected via a radio link. The SCRA central is interconnected to a PTARMIGAN switch either by radio or via cable. In the U.K. system all SCRA terminal calls must go through a SCRA central and then to a switch where the SCRA switching function is performed. The U.K. anticipates that they can satisfy their mobile subscriber needs for a corps area with approximately 600 SCRA terminals.

The German approach to SCRA is under review but appears to have been conceived as an extension of the forward area communications to the rear. The generalized German concept for SCRA as shown in the chart depicts mobile subscriber terminals and centrals. The terminals have the capability to talk directly to each other without going through a central or a switch. A possible implementation of the German concept uses the SEM net radios (with automatic channel selection) as the mobile terminal.

Additional information on radio telephone implementation concepts can be found in Appendix E.

NATO SCRA
Operational Requirements Status



*TRI-TAC/Objective System Concept

Ⓢ Switch □ Mobile Subscriber

Ⓒ Central △ Access Unit

4.3.2 Operational Requirements for a Common SCRA

The inability of the major NATO powers to agree on the operational requirements for a mobile subscriber radio telephone concept, or, as it is referred to within the EUROCOM nations, an SCRA concept, has been the biggest difficulty in establishing a coordinated approach to a mobile subscriber system. The EUROCOM SCRA working group has held many meetings in the past several years in attempts to obtain agreement on common operational requirements for SCRA. Four levels of interface for SCRA have been identified.

Level 1 (L1) refers to an operational requirement that would permit the SCRA terminals of one nation to access the SCRA central of another nation. Agreement could not be reached on this approach.

Level 2 (L2) refers to an operational requirement that would allow a SCRA terminal of one nation to access the SCRA central of another nation. Agreement on operational requirements also could not be reached at this level.

Level 3 (L3) refers to an operational requirement for access between the SCRA centrals. This will be the subject of the next round of discussions among the NATO nations. If agreement cannot be reached on an operational requirement for Level 3 interoperability between SCRA equipments, then the fall back position will be Level 4.

Level 4 (L4) is an operational requirement for access between switches. Agreement on Level 4 SCRA operational requirements would be academic since this capability will be in place in the near-term as a result of the STANAG 5040 agreements for inter-connection of the analog switched networks. Similarly, the digital trunk group interface agreements will provide this level of interoperability when the digital networks are fielded.

Although agreements have not yet been reached on mutually acceptable operational requirements for Levels 1, 2 and 3 modes of interoperability, the NATO ministers have set as their goal some sort of understanding. Ultimately, other factors (economic, political, etc.) may contribute to reaching agreement.

Outlook
SCRA/MSE

- Cooperative Development Is a Key NATO Initiative
- Harmonization of Mobile Subscriber Concepts Is Difficult
- MSE Still in Concept Validation Stage
- Possible "Two-Way Street" Initiative

4.3.3 Outlook SCRA/MSE

As we have seen, the NATO ministers have called for resolution of common SCRA operational requirements and for cooperative SCRA development. These actions, however, pose a difficult tactical communications problem for the Alliance.

The U.K. has defined operations requirements and equipment configuration for their mobile subscriber service and has built prototype hardware. The U.K. mobile subscriber radio-extension service is based on compatibility with the U.K. mobile tactical switched system (PTARMIGAN switches and TRIFFID RF transmission links) that will be deployed in Germany.

Germany, on the other hand, is still in the process of defining its mobile subscriber requirements. However, the German requirements are based on a different set of needs. The German tactical switched system includes the AUTOKONETZ mobile switches but uses the fixed German PTT network rather than mobile RF equipment to provide the transmission links. Ready access to the PTT network and the use of the GRUNDNETZ (wire drops already in place in strategic locations) increases the access to the tactical switched system and simplifies the task for the Germans to provide for their mobile subscribers.

The U.S. mobile subscriber requirements are structured to include potential worldwide deployment and are required to be compatible with and to complement a tactical switched system wherein both the switches and transmission links are mobile. The U.S. has used the mobile subscriber requirement as the basis for the development of a new concept in Division/Brigade tactical communications. The U.S. Mobile Subscriber Equipment (MSE) as defined by INTACS not only provides the radio-telephone extension function to the Mobile Subscriber, but also provides telephone service to all non-mobile (static) subscribers. In doing this it eliminates the existing AN/TRC-145 multichannel RF transmission links between division and brigade.

These differences in philosophy to the concept of mobile subscriber service translate into differences in hardware complexity, system architecture, and cost-to-implement. Harmonization of these differences to permit agreement on operational requirements and development of a NATO SCRA Standard are current NATO working goals. As a contender for this standard, the U.S. MSE concept appears to be the most complex (hence costly), and duplicates in part, functions already in place (e.g., European PTT networks) or planned (e.g., extensions of mobile RF transmission links) by the British and Germans. Changes have occured in the MSE concepts throughout its evolution. Further changes are likely due to both the updating of the INTACS Objective System and the emergence of a requirement for a data distribution system that might also be able to satisfy the needs of the mobile subscriber.

The U.S. MSE concept and U.K. SCRA system are both rooted in the joint U.S.-U.K.-Canada-Australia Project Mallard which was conducted during 1967-69. Project Mallard was an attempt to achieve cooperative international development of compatible tactical digital communications systems. The goal was interoperability and economy through commonality of equipment.

When the U.S. withdrew under U.S. Senate recommendation that priority be given to achieving Tri Seavin interoperability, the U.K. continued the effort and developed a system that has since become known as the PTARMIGAN system which includes the SCRA. The U.S. began the TRI-TAC program which includes the MSE.

Given the common roots of MSE and SCRA, the fact that the U.S. and U.K. are not too far apart and that the MSE concept is still evolving in the U.S., this area may be particularly fruitful for a "two way street" initiative. This would be a good opportunity for the Army to take the lead.

TACSATCOM
Interoperability

- US Leading Equipment Development
- Modest Effort in UK
- Poor European Perception of Benefit to Cost
- No Problem Now

4.4 TACSATCOM

4.4.1 Tactical Satellite Communications Interoperability

The U.S. has embarked upon an ambitious tactical satellite communications development program for ground mobile forces. Both single channel and multi-channel ground terminals and the satellite transponders to support them are planned for as early as 1980. A very modest satellite communications development effort is under way in the United Kingdom. The other NATO nations have been very slow to start development of tactical satellite communications equipment. There is no significant problem with satellite communications among NATO nations now because the majority of equipment that is fielded or planned is U.S. equipment.

European reluctance to start satellite communications programs for military applications can be attributed to the large cost to develop terminals and the satellites themselves. These factors have contributed to a perception by the European nations that the benefits that might accrue from a tactical satellite communication system are not commensurate with the comparatively large costs to implement such a system. Tactical satellite communications development programs underway in the U.S. and Europe are described in more detail in Appendix F.

Outlook
TACSATCOM

- **Need To Identify Incentives for European Use**
  - **National Switched Systems Interface**
  - **Unique Applications**
- **Opportunity To Take Lead in Development of Equipment Interoperability Guidelines**

4.4.2 Outlook TACSATCOM

The United States lead in the development of tactical satellite communications equipment represents an opportunity for the Army to initiate the development of NATO tactical satellite communications standards. European perceptions of high costs and small benefits will impede introduction of tactical satellite communications into the Allies' military communications systems unless the capabilities of TACSATCOM in a European environment (e.g., providing communications for underground CP's, etc.), can be identified. Ways need to be found to reduce costs of terminal equipment and to insure space segment availability for these links.

Army Data Distribution System (ADDS)

- ADDS Will Satisfy Requirements for "Bursty" Battlefield Data
  - JTIDS
  - PLRS PLUS
  - Packet Radio
- Europeans Have Similar Digital Data Distribution Concepts
  - MIDS
  - ERCS
  - MACS II
  - SINTAC
- Opportunity for Early Coordination with NATO

4.5 Army Data Distribution System (ADDS)

The Army is developing requirements for an ADDS to accommodate digital data communications on the battlefield. ADDS will support the digital data transmission needs of the ground forces that are characterized as "bursty," i.e., relatively short messages transmitted at irregular times with comparatively long intervals between messages. At this time the candidate concepts for ADDS development are: the Joint Tactical Information Distribution System (JTIDS), an upgraded position location reporting system (PLRS PLUS) and Packet Radio. Information on these concepts is provided in Appendix G.

NATO nations are working on digital data transmission concepts, similiar to JTIDS, such as: the German Multiple Access Communication System (MACS II), the French SINTAC, and the British ECM Resistant Communications System (ERCS). NATO's concern over the ability of these systems to work together prompted the TSGCEE to establish the Sub-group on Multi-functional Information Distribution Systems (Sub-group 3) to coordinate development of these systems. Sub-group 3 was tasked to develop an overall concept of the roles that these Multi-function Information Distribution Systems (MIDS's) could play in communication, navigation, and identification. This Sub-group was also tasked to seek agreement on the adoption of a common system or to seek agreement on measures necessary to assure interoperability and compatibility among the existing or planned systems. Sub-group 3 has prepared in draft form: operational requirements, identification of system capabilities, and performance concepts for a common NATO MIDS concept.

The focus of the ADDS concept currently is on providing support to Army ground forces. While the NATO MIDS and the other European concepts are at the present time focused on air-to-air or air-to-ground communications, there appears to be overlap between these concepts and ADDS. This is evident in the choice of JTIDS as a candidate ADDS concept. Since it is reasonable to assume an increase in Army data distribution requirements of the type supported by ADDS, the Army should take this opportunity to work with the NATO Sub-group on MIDS to coordinate its operational requirements with those of the other NATO nations.

Conclusions

- **Communications Interoperability Good and Getting Better**
- **No Problem in Terrestrial Switched Networks**
- **No Problem Now in CNR**
  - **Possible ECCM Problem Later**
- **Given CNR Interoperability, Need for MSE/SCRA Interoperability Not Clear**
- **Opportunities for U.S. Initiatives:**
  - **MSE/SCRA**
  - **SINCGARS ECCM**
  - **TACSATCOM**
  - **ADDS**

5.0 CONCLUSIONS

MITRE's review of the tactical communications capabilities of the NATO nations indicates that equipment interoperability among the Allied tactical communications systems is reasonably good and getting better. Progress is being made in developing interfaces for existing equipment and planning is underway to make the future generations compatible. However, compatible communications equipment is only one of the elements required to achieve interoperability among the forces of the NATO Alliance. Agreement on common military operational requirements, doctrine, tactics, procedures, etc. and a resolution of political, philosophical, economic, and legal constraints, to name but a few, will also be required. Impediments in these areas hinder greater overall interoperability among the Allied military forces. Several subsidiary conclusions can be drawn about specific areas where improved equipment interoperability may be achieved.

Hardware interoperability between current and TRI-TAC terrestrial tactical switched networks appears well under control and does not pose a significant problem now. Analog interoperability will be achieved through the use of interface devices as outlined in STANAG 5040. These interface devices are a realistic, attainable means for providing interconnections between existing systems. Agreements between the U.S. and other NATO nations will determine the operational requirements for the quantity and location of these devices. Hardware interoperability for digital switched networks, is also being addressed. The prefered solution provides interface connections for these networks at the trunk group level. Preliminary technical agreements for trunk group digital interfaces have been reached through EUROCOM and TSGCEE efforts. In summary, ways to provide good technical interoperability between the U.S. and NATO national tactical switched systems have been identified and are being implemented.

There is good equipment interoperability between current U.S. combat net radios (CNR's) and those of the other NATO nations. There is considerable frequency overlap and sufficient standardization of technical parameters so that U.S. CNR's can provide voice links with NATO nation CNR's. A CNR secure voice capability will exist between the U.S. and the U.K. in the near future. NATO secure voice standards will be agreed upon in the near future. Agreement on ECM resistance standards are further away. Unilateral U.S. adoption of a frequency hopping SINCGARS may decrease the technical interoperability of U.S. radios with radios of other NATO nations in an ECCM mode when SINCGARS is deployed.

NATO nations have rejected agreement on SCRA operational requirements at Level 1 and Level 2. At this time, agreement at Level 3 is uncertain. Without this operational requirement, the need to make MSE and SCRA interoperable is not clear. Military requirements, economic and philosophical constraints, as opposed to technical constraints, are at the root of the NATO SCRA problem.

Key opportunities for U.S. initiatives with NATO allies include:

- Possible use of NATO SCRA concepts to provide local traffic MSE function through early 1990's.
- Adoption of SINCGARS ECCM as NATO standard.
- Development of NATO-wide TACSATCOM standards.
- Coordination of the operational requirements for battlefield data distribution among the NATO nations.

Recommendations

- **Develop Interoperable CNR ECCM**
  - EUROCOM/NATO Standards
  - Coordinate with UK
  - Evaluate GE ECCM Proposal
  - Share US Development Experience with Allies
- **Evaluate SCRA Radio Extension to US Multichannel for Mobile Subscribers**
- **Lead NATO Tactical Satellite Standards Development**
- **Invite European Participation in ADDS Development**

6.0 RECOMMENDATIONS

Based on these conclusions, MITRE recommends that the U.S. Army:

- Establish the lead in developing a common or compatible ECCM approach for NATO CNR. This should include: continuation of efforts to influence NATO standards on ECM resistance, monitoring of efforts to develop CLANSMAN ECCM add-on or retrofit (post 1983 time frame), and review of NATO country developments in ECM resistance concepts (e.g. FRG proposed SINCGARS fly-off ECCM module). Given the U.S. lead in this area by virtue of the SINCGARS program, efforts should be mounted to share U.S. development experience with U.S. allies.

- Evaluate the use of a NATO SCRA concept to satisfy the voice communication needs of the mobile subscriber through the early 1990's.

- Establish the lead in developing NATO tactical satellite communications standards.

- Seek NATO nation participation in the early definition of operational requirements for a land-forces data distribtuion system. Conduct ADDS development to be compatible with MIDS and combined NATO nation operations in the European area.*

*Since this briefing was presented in October 1978, the U.S. has proposed to the TSGCEE that a full-time study group be established to exploit the MIDS concept and technology in ground and maritime warfare as well as in air warfare. This proposal received the full support of the TSGCEE and plans are underway to establish a MIDS Team by July 1979.

APPENDIX A
DEFINITIONS OF TERMS RELATED TO RSI

The terms shown below are frequently used in the RSI Program. These definitions have been approved as DoD terms for inclusion in JCS Pub 1 - DoD Dictionary of Military and Associated Terms.* Those marked by an asterisk are also NATO approved definitions.

Collocation (Co-location): The physical placement of two or more detachments units, organizations, or facilities at a specifically defined location.

Commonality: A quality which applies to materiel or systems possessing like and interchangeable characteristics enabling each to be utilized or operated and maintained by personnel trained on the others without additional specialized training; and/or having interchangeable repair parts and/or components; and applying to consumable items interchangeably equivalent without adjustment.

*Compatibility: Capability of two or more items or compontents of equipment or materiel to exist or function in the same system or environment without mutual interference.

Consolidation: The combining or merging of elements to perform a common or related function.

Harmonization. The process and/or results of adjusting differences or inconsistencies to bring significant features into agreement.

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*H. Brown, Rationalization/Standardization Within NATO, DoD Fourth Report to U.S. Congress, January 1978, Appendix A.

*Interchangeability: A condition which exists when two or more items possess such functional and physical characteristics as to be equivalent in performance and durability, and are capable of being exchanged one for the other without alteration of the items themselves or of adjoining items, except for adjustment, and without selection for fit and performance.

Interconnection: The linking together of interoperable systems.

Interoperability: The ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together.

Interoperation: The use of interoperable systems, units, or forces.

Rationalization: Any action that increases the effectiveness of Allied forces through more efficient or effective use of defense resources committed to the Alliance. Rationalization includes consolidation, reassignment of national priorities to higher Alliance needs, standardization, specialization, mutual support, improved interoperability or greater cooperation. Rationalization applies to both weapons/materiel resources and nonweapons military matters.

Specialization: An arrangement within an alliance wherein a member or group of members most suited by virtue of technical skills, location, or other qualifications assume(s) greater responsibility for a specific task or significant portion thereof for one or more members.

Standardization: The process by which member nations achieve the closest practicable cooperation among forces; the most efficient use of research, development, and production resources; and agree to adopt on the broadest possible basis the use of (a) common or compatible operational, administrative, and logistics procedures; (b) common or compatible technical procedures and criteria; (c) common, compatible, or interchangeable supplies, components, weapons, or equipment; and (d) common or compatible tactical doctrine with corresponding organizational compatibility.

NATO National
Tactical Switched Systems

COUNTRY	SYSTEM NAME	FIELD DATE	INTERFACE CONCEPT	SUBSCR LOOP	SWITCH	ROUTING	CHANNEL BITRATE	REMARKS
US	ATACS	In field	D-55	A	ADC	TABLE	48 kb/s-PCM	
	TRI-TAC	1983+	Trunk Group	D	H	LOOK-UP	16/32 kb/s-Δ	CVSD Mod.*
UK	BRUIN	In field	D-55	A	ADC		42 kb/s-PCM	
	PTARMIGAN	1983+	Trunk Group	D	D	Delegated	16 kb/s-Δ	Delta Mod.*
GE	AUTOKONETZ	1977	D-55	A	MDC	Destination Search	16 Kb/s-PCM	Computer Controlled Relays
	AUDINETZ	1995+	?	D	D	?	?	?
FR & BE	RITA	1980	D-55	A	ADC	Saturation	48 kb/s	
			?					Delta Mod*
IT	CATRIN	1985	Trunk Group (to EUROCOM Nets) - D-55 (to NATO Nets)	A	D	Saturation	16/32 kb/s-Δ	Keyed to EUROCOM Standards
NE	INTERIM System	In field	?	?	?	?	?	
	ZODIAC	1985+	?	?	?	?	16 Kb/s-Δ (?)	Delta Mod.*

A - Analog
D - Digital
H - Hybrid A/D

ADC - Digitally Controlled Analog
MDC - Digitally controlled mechanical
CVSD - Continuously Variable Slope Delta

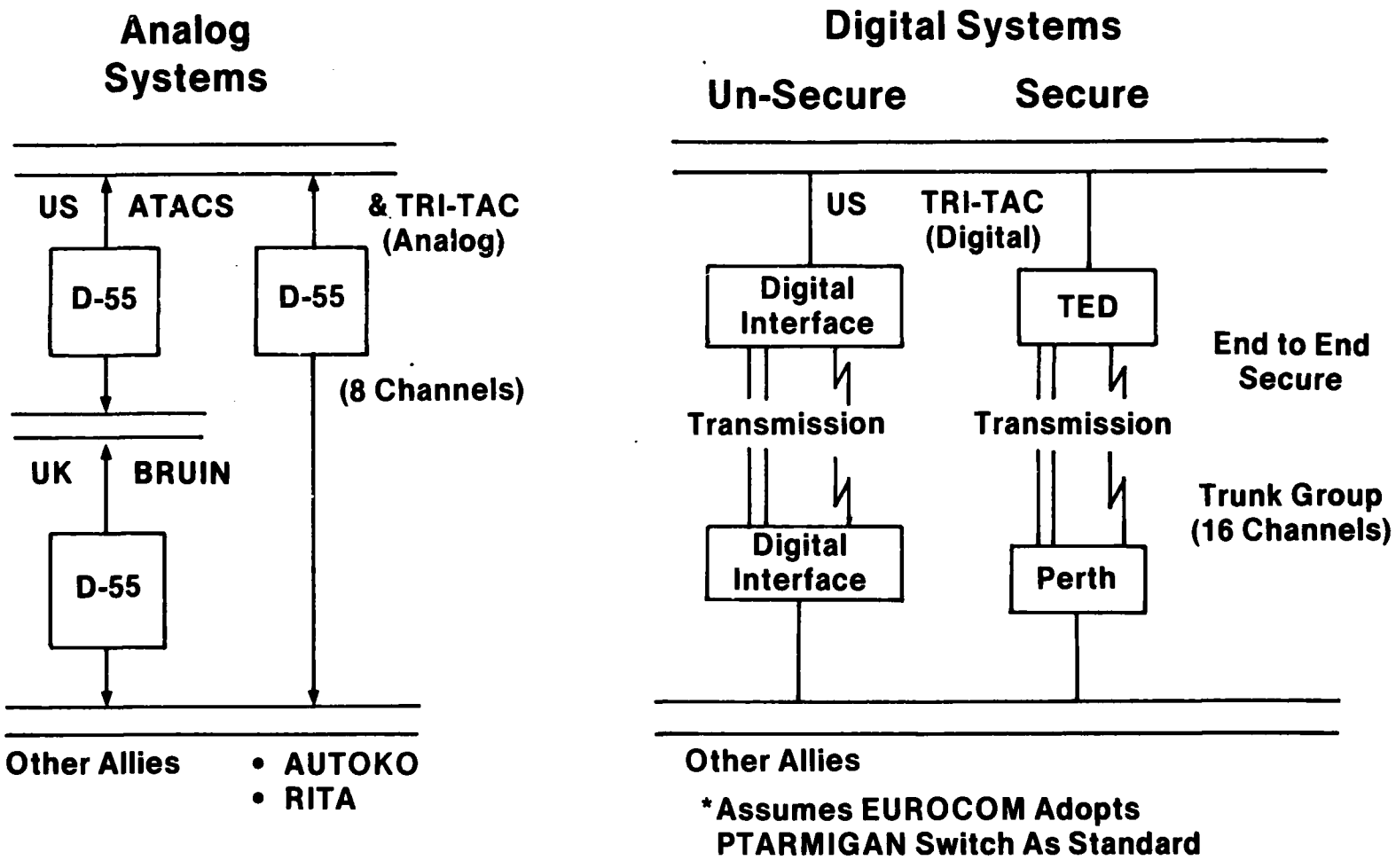
CC - Command Channel
IB - In Band
* - Analog Mod Scheme

APPENDIX B

NATO NATIONAL TACTICAL SWITCHED SYSTEMS

This chart provides comparative information on tactical switched systems that will be fielded by the NATO nations. Differences among the systems are evident even within the small selection of parameters chosen for this chart. The CVSD and delta analog modulation schemes that have been identified for use with the TRI-TAC and PTARMIGAN systems have been reported to be compatible with each other.

Planned Interface Concepts
US & NATO Countries



APPENDIX C

PLANNED SWITCHED SYSTEMS INTERFACE CONCEPTS

Agreements among the Eurogroup countries regarding standards to be applied to near-term (through 1985) interoperability for the national switched systems are well in hand. STANAG 5040 is approaching final agreement with only minor revisions remaining to be included. This STANAG defines the parameters for a NATO Interface Device (NID) that will allow interconnection of the analog switched systems that will be operating in the European environment in the near to mid-term. Prototype NIDs have been implemented in a device called the D-55 Interface Box, by Germany and France in the fully automatic version, and the U.K. in a semi-automatic version. These devices have been tested by the three countries both individually and together and the results confirmed the approach taken under the STANAG. The U.S. has also built automatic prototypes of this device and will use the D-55 Interface Box concept with both the current AN/TTC-38 analog circuit switch and the AN/TTC-39 TRI-TAC hybrid switch. Joint tests of these devices are planned among the four countries early in 1979. The chart shows how the D-55 Interface Box could be interconnected between the U.S. systems and systems of the other nations.

Digital trunk group interoperability is considered to be essential for effective NATO operations after 1985. Agreements are being worked out among the Eurogroup nations and the U.S. to define standards for a trunk group digital interface. The interface will be compatible with either RF or cable transmission between digital switched systems of the different nations. Agreements have been made between the EUROCOM Subgroup and the U.S. to provide encrypted trunk group interoperability. The U.S. and the U.K. have defined a 16 channel trunk group interface standard which will allow secure transmission between the TRI-TAC equipment using the TED encryption device and the U.K. PTARMIGAN equipment using the PERTH encryption device.

NATO National Combat Net Radios

	SQUAD RADIO	MANPACK	VEHICULAR SHORT RNG.	VEHICULAR LONG RNG.	RETRANSMISSION	GND TO AIRCRAFT
US Current Inventory	PRC-68 (Devel.) PRT-4, PRR-9	PRC-25	PRC-25/77 (Family)	VRC-12 (Family)	Man pack and Vehicular-Tandem Operation	ARC-114
SINCGARS	-	Manpack Subsystem	Short Range Veh. Sub-system	Long Range Veh. Sub-system	Repeater (Not defined)	Aircraft Radio Subsystem
UK Current Inventory	-	A-40	C42, C45	B47, B48	Tandem Operation	-
CLANSMAN (UK)	PRC-349	PRC-350 PRC-351/2	VRC-353 VRC-351/2	VRC-353	Unattended Tandem Operation except PRC-349	-
GE Current Inventory	-	SEM 35	SEM 35	SEM 25	Tandem Operation	SEM 35
Next Generation	SEM 52	SEM 70 (ACS)*	SEM 80 (ACS)*	SEM 90 (ACS)*	Tandem operation	SEM 70

*ACS - Automatic Channel Selection

APPENDIX D

NATO NATIONAL VHF COMBAT NET RADIOS

This chart identifies the current inventory and next generation combat net radios of the U.S., U.K. and Germany. The equipment is grouped by class of planned use. The U.K. does not use VHF equipment for ground to air communications.

NATO SCRA Concepts

COUNTRY	SCRA NAME	FIELD DATE	SCRA Interoperability*	REMARKS
US	MSE (TRI-TAC)	1986+	No (?)	Configuration concepts under review.
UK	SCRA (PTARMIGAN)	1983+	Yes	Contractor field trials '78 to '79. UK deploys SCRA from battalion to corps.
GE		Mid 1980's	No	UK and GE do not agree on SCRA operational requirements. GE favors use of net radio interface to support mobile subscriber. Deploys SCRA forward of Bde.
FR	LIRSAC	Early '80's (?)	No	Rita Radio Integration uses 19.2 Kb/s delta modulation with syllabic compression.
IT	SCRA (CATRIN)	Mid ('80's)	Yes (?)	Development concepts stressed EUROCOM compatibility.
NL	-	-	-	SCRA concepts not identified.
BE	-	-	-	

*Assumes PTARMIGAN architecture chosen for EUROCOM standard

APPENDIX E

NATO SCRA CONCEPTS

This chart summarizes information on NATO SCRA concepts. The U.K.-SCRA is compatible with the PTARMIGAN architecture and hardware implementation has begun. The other systems are still in the conceptual stage. Several European countries have indicated that they will develop SCRA in conformance with EUROCOM standards. These standards have not been agreed to at this time, however, the U.K. has the lead in hardware development. An estimate of interoperability between elements of one country's SCRA system with elements of an other country's SCRA system is shown. This estimate assumes that PTARMIGAN architecture is chosen as the EUROCOM standard.

Tactical Satellite Ground Terminal

COUNTRY	Gnd TERMINAL	SC MC	FDMA TDMA	UNF NF	SPACE SEGMENT	FIELD DATE	REMARKS
US	AN/TSC-85	MC	F	S	DSCSII or III	80's	4 LINKS-(NODAL TERMINAL)
	AN/TSC-93	MC	F	S	DSCSII or III	80's	1 LINK-36kb/s per chn.-(576 kb/s trnk. grp) ATACS
	Multi-Chan. SHF (Objective System	MC	T	S	DSCSII or III	90's	18, 36, 144 chn. (36kb/s) (TRI-TAC compatable)
	S/C SHF DAMA (TTY TERM) (objective system)	SC	T	S	DSCS III	90's	C^2 - stand alone - objective system - single channel record traffic
	PSC-1 & VSC-X (UHF-MANPACK)	SC	F	U	FLEETSATCOM GAP FILLER (GPSCS late 80's)	82	burst mode-separate assigned freq.- data & voice - 16kb/s CVSD- stand alone system - interop not intended
	MSC-65 (TTY TERM)	SC	T	U	SAME AS MANPACK	80's	C^2- DAMA - stand alone - replaces HF-RATT-net near term - no interface with switched network
UK	TSC 500	SC		SHF	?	in field	2-secure 2.4 kb/s VOCODER speech channels
	TSC 501	MC	T	SHF		82	- larger/more sensitive version TSC 502
	TSC 502	SC	T	SHF		79	- hand steerable 5' antenna

*MC-multichannel; SC-single channel

APPENDIX F

TACTICAL SATELLITE GROUND TERMINAL DEVELOPMENT PROGRAMS

This chart lists U.S. and U.K. tactical satellite ground terminal development programs that were identified during this study. The AN/TSC-85 and the AN/TSC-93 are being developed to be interoperable with the existing ATACS equipment. The multi-channel SHF terminal (objective system) is a conceptual development that will be used to support transmission requirements for area systems using the TRI-TAC digital hardware. The single channel terminal (objective system) is a conceptual development that will be used to support record traffic transmission when the objective system plan is implemented. The single channel PSC-1 and VSC-X UHF ground terminals are part of a stand-alone communications concept that is not intended to be interoperable with the area systems using TRI-TAC architecture. The MSC-65 is also a stand-alone concept. It is planned to be used as a replacement for the HF-RATT-net teletype systems currently in use.

The TSC series of ground terminals will provide the U.K. with a means to provide a limited number of communications channels to forces deployed at very long ranges from the British Islands. U.K. satellite ground terminal development planning does not include operational requirements for satellite communications over the comparatively short range from forward echelon to corps or echelon above corps.

ADDS
Candidate Concepts

	TYPE SYSTEM	NETWORK ORIENTATION	REMARKS
JTIDS	I - SYNCRONOUS TDMA II - DISTRIB. SYNCH. TDMA	RECEIVER	MASTER STATION REQUIRED TO GENERATE SYNCH AND PROVIDE SYSTEM/EXECUTIVE CONTROL - ANY STATION MAY BE DESIGNATED AS MASTER
PACKET RADIO	PACKETIZED DATA - RANDOM ACCESS - FLOOD DISPERSION	ORIGINATOR	PACKETS HAVE DESTINATION ADDRESS - FLOOD THRU SYSTEM UNTIL DESTINATION IS REACHED - RECEIVED ACKNOWLEDGE IS RETURNED TO SENDER
PLRS PLUS	MASTER/SLAVE POSITION CALCULATION, WITH DATA CAPABILITY	ORIGINATOR	USER UNIT (SLAVE) REQUESTS POSITION - MASTER TAKES USER DATA, COMPUTES AND SENDS USER POSITION. ADDITIONAL MESSAGE CAPACITY ADDED TO PROVIDE DATA HANDLING CAPABILITY

AD-A082 448 MITRE CORP MCLEAN VA F/G 17/2
ARMY COMMUNICATIONS INTEROPERABILITY WITH NATO NATIONS.(U)
APR 79 W F DE DUFOUR F19628-79-C-0001
UNCLASSIFIED MTR-8016 NL

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APPENDIX G

ARMY DATA DISTRIBUTION SYSTEMS (ADDS) CANDIDATE CONCEPTS

This chart identifies the three concepts that are currently considered to be candidates for ADDS. JTIDS was conceived primarily as an air to air or air to ground data communications system. A third version, JTIDS III, is under study. JTID III would be a manpack version of the JTIDS concept. Packet Radio field experiments have been performed to obtain empirical data on this concept. This concept is still in the experimental stage. The Position Location Reporting System (PLRS) is a concept originally conceived to provide a means to determine the relative geographical position of a receiver. This concept has been expanded into a PLRS PLUS configuration that provides a larger data handling capability to the original concept.

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